THE IOT-BASED SMART SHOPPING TROLLEY SYSTEM

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Abstract— **This research paper presents an IoT-based smart trolley system for supermarkets that aims to provide customers with an improved shopping experience. The system consists of a smart trolley equipped with sensors and microcontrollers that interact with a cloud-based server and a mobile application. This involves designing the hardware and software components of the smart trolley, including the IoT sensors, RFID reader, microcontroller, display screen, and user interface. The system will communicate with a cloud-based server that stores and processes data from the sensors and provides real-time analytics for store managers**. **The trolley can detect the items placed in it and display the total cost of the purchase on an LCD screen. The mobile application allows customers to view the list of items in their trolley, their prices, and the total cost, search for items, and navigate to their locations in the supermarket. The cloud-based server collects and analyzes data from the trolleys and generates insights for supermarket management, such as popular products, inventory levels, and customer footfall. The proposed system has the potential to enhance the shopping experience for customers and provide valuable insights into supermarket management**.

Keywords— RFID Tag, RFID Reader, Microcontroller, Display screen, QR Scanner

I. INTRODUCTION

Our ideas and expectations are changing significantly as a result of numerous advancements and information technologies over the course of the century. Shopping is a common activity where people spend the most time. According to a survey, people spend between one and two hours shopping, and most people always have a tendency to leave a long line of people behind them. Every supermarket and shopping center in the modern day has a shopping cart and baskets for patrons to keep their purchases. Customers must proceed to the billing counter for checkout once their purchasing is complete. Here, the billing procedure takes a long time and necessitates adding more staff to the purchase. We are adopting an RFID-based smart trolley system to reduce traffic, save time, and eliminate manual labor as a solution to this issue. Our prototype contains a few improved features that will fix the queue problem. The smart trolley system includes an Arduino Uno, Buzzer, LCD Display, RFID Tag, and RFID Reader. A product has an RFID tag connected to it. The RFID reader automatically scans the products as a person places them in the trolley, and the information about the product name, price, and quantity is shown on the LCD.

II. RELATED WORK

A. Smart shopping trolley using RFID

The mall and market are great places for customers to buy the items they need on a daily basis, such as name-brand groceries, clothing, and home décor. A consumer uses an RFID reader to scan the item and place it in a shopping cart after traveling to a mall to do his or her shopping. The quantity of the goods is then shown on the LCD, helping the customer establish a budget. Every item has an RFID tag. If the consumer decides against buying the item, he will scan it once more, and it will then be taken out of the trolley. The customer will use the push button in the shopping cart to complete the billing once he is through shopping.[1]

B. RFID-based shopping trolley with IR sensor

Even if individuals are currently highly busy with their schedules, they still need to make time to go shopping and acquire whatever they need in order to meet their fundamental necessities. They lose time once more waiting in those long lines at the checkout in the mall. Also, there is a large crowd that causes other customers to have issues; our system was launched to solve this issue. The barcode scanner on the item that the customer wishes to purchase reads the our system's LCD screen is built-in and has an RFID tag attached to it that displays the item's pricing. The total amount will be shown on the LCD when the consumer is ready to pay for all of the products. Using a ZigBee connection from the host computer, the cost of the product is supplied to the microcontroller. Zigbee enables two-way communication between the host PC and the microcontroller. The backlog is ultimately reduced since the client receives a direct bill in the billing part that is already stored on the host Computer. [2-3]

C. RFID-Based Smart Trolley for Automatic Billing System

In the paper, the "Elegant Shopping Cart System" is presented, which will use an RFID reader, transmitter, and receiver to calculate the cost and save a record of the products that are purchased. Based on a consolidated database of user purchases, the system will offer product recommendations. Each product in the market is attached to an RFID tag in the "Smart Shopping Cart System," Moreover, an RFID reader is included with each trolley, an LCD display, an alphanumeric display, a transmitter, and a receiver.[4]

D. *Shopping and Automatic Billing Using RFID Technology*

In order to construct an "on the spot" billing supermarket, this article offers an architecture that combines radio frequency identification (RFID) with wireless technologies. The shopping cart utilizes an RFID reader and tag-based system application, and as a result, RFID cards are employed as secure access to the goods. The product name, price, and total value of all the items purchased are displayed on the liquid crystal display (LCD), which is mounted on a cart. Using ZigBee connectivity, the host computer creates foot notation. The Proteus software system and hardware are used to simulate software systems and the microcontroller 18F46K22 respectively.[5]

E. *A Deep Learning Enabled Smart Shopping Cart*

This study utilized the q-learning and YOLO algorithms to develop a deep-learning CNN method (You Only Look Once). For product analysis and object detection, YOLO algo is employed. YOLO find the item in the trolley. The YOLO algorithm does a good job of predicting the object in the box. It operates quickly and detects the object or objects clearly. Q-learning grows off of prior knowledge on its own. The trolley's contents are located by YOLO and Q-Learning. With the use of a management tool, they were able to track the trolley's location and control its motions. They are in charge of the trolley, yet they are unable to escape. The trolley is entirely under internet control.[6]

F. *Smart basket algorithm approach used for shopping in supermarkets using a rechargeable smart cart*

The authors of this study make use of an RFID card, reader, and tag as well as a GSM module. The product has an RFID tag that provides the product description, which the RFID reader reads. Each user receives an RFID card for payment, and each client must recharge the card in order to pay bills at a mall or store.
The customer presses the start button on the shopping cart to begin their purchase. The customer must click the end button after making a purchase. In order to generate the bill and transfer it to their phone number, the end button sends data to the Arduino and GSM module. The customer pays the invoice amount using an RFID card that may be recharged.[7-9]

III. PROPOSED SYSTEM

This is the current shopping system used in supermarkets and malls. The item(s) being purchased must be taken by the consumer and placed in a cart. After making his selections, he must proceed to the billing counter and stand in line until it is his turn to pay. When he finally approaches the counter after standing in a long line, the barcode reader must scan each item in order to create the final bill. This is a highly laborious and time-consuming task. We have suggested our system, which operates as follows, to make consumers' shopping quick and simple. Each item in the store will have a distinct RFID tag attached to it.
The RFID reader built into the cart will read the tags as soon as a customer chooses the products they wish to purchase and as soon as the user places the things in the cart in order to identify the items for billing. On the trolley's LCD display, the item's name and price will be shown. The customer will press the submit button on the cart when he is finished. Following the creation of the final bill, all information regarding the things that were purchased will be pushed for billing. Simply give the specific trolley number of your trolley when you approach the billing counter, and you will receive a printed charge. He can settle the bill right away and leave the store to continue working.

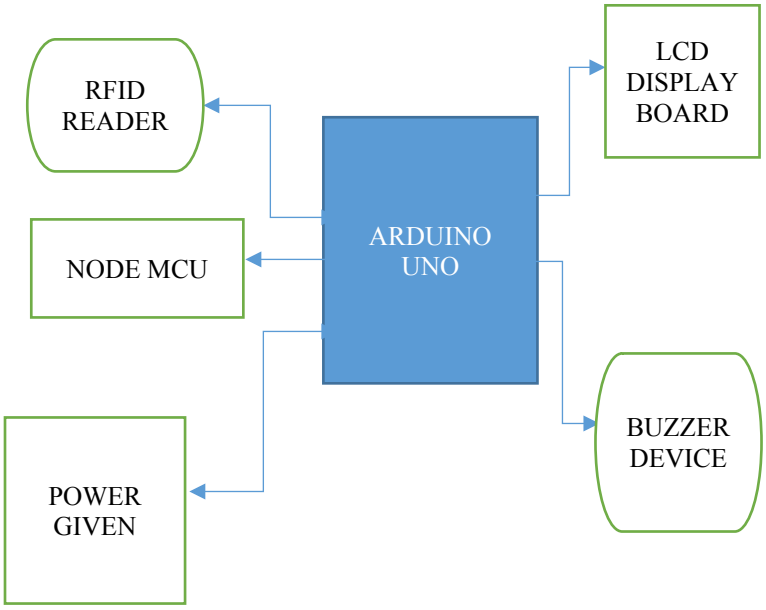

Fig 1: Block Diagram [7]

IV. ALGORITHM USED

STEP 1: The cart is originally at reset.
STEP 2: After that, the reader reads the RFID TAG. In the event that the tag is read an odd number of times, the item is placed to the shopping cart.
STEP 3: If the RFID TAG is scanned an even number of times, the cart is deducted.
STEP 4: Once more, the complete billing amount is shown on the LCD screen after hitting the reset button.

STEP 5: Then the sum of the amount is taken out of the cart using the pre-charged cart.
STEP 6: Once the final billing is completed, sent via the HC-12 transmitter, and seen by the appropriate person in the billing section.[10-14]

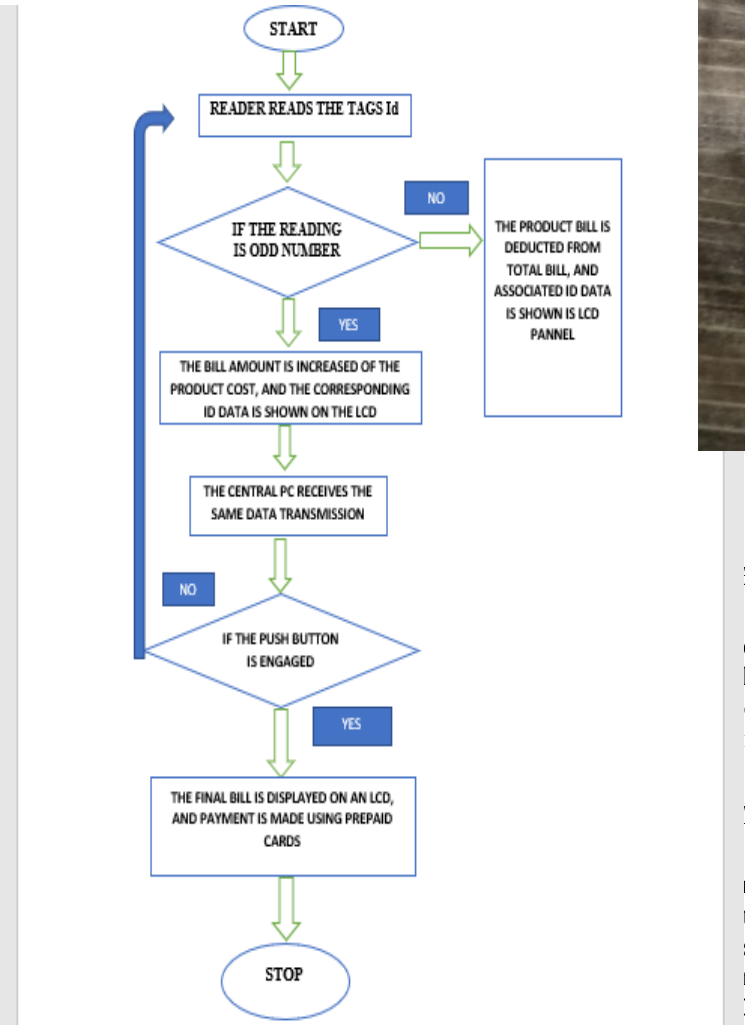

Fig 2: Flow Chart

V. HARDWARE USED

A. ARDUINO UNO FOR CREATING BILLS

In 2010, Arduino. cc released the first version of their public-domain microcontroller board, the Arduino Uno. The Microchip ATmega328P is the main part of Arduino Uno. Input and Output pins on the board are made of both analog and digital pins, where many connection boards and other circuits can be connected. The board has six analog input and output pins, and fourteen digital input and output pins where six of which may create Pulse width modulation and is programmable through a type basic(B) Universal serial bus cable using the Arduino IDE. In addition to operating within the range of 7-20 volts, it may also be powered by a Universal serial bus cable or a nine-volt battery. The Commons attribution two decimal five licensed is on the webpage for Arduino, which is bundled with the hardware reference module. Accessible layouts and production files are also available for specific hardware variants.[15],[16]

Fig 3: Arduino UNO Board

BUZZER

uzzer is an aural signaling tool that can be either hanical, electromechanical, or piezoelectric (abbreviated o). Alarm clocks and timers are two common ications for buzzers and beepers.[17]

LCD

rucial component of an embedded system is a liquid tal display. It gives the user a lot of versatility because he show the necessary data on it. The LCD is connected to microcontroller through the LCD driver. We adjust the D's contrast, the interface mode, the display mode, the direction in which the address counter increments, the horizontal or vertical addressing mode, and the color format. Initialization is followed by the transfer of data bytes to the required RAM memory region for the display data.
It is necessary to first provide the location using the set command byte before delivering data bytes and Double data random access memory write command used to send data byte. One of two typical layouts for connections is either 2 series rows of 7 pins or 1 series row of 14 pins.[18],[19],[20]

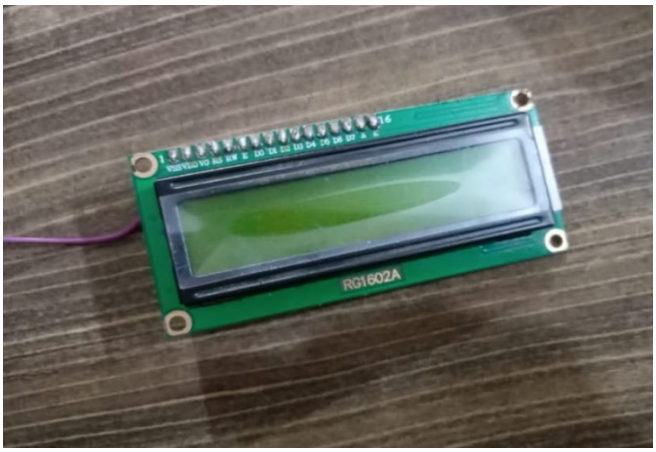

Fig no 4: LCD

D. RFID RC522 READER

While the Arduino uno is constantly in communication with the server, the RFID reader will assist in scanning the product id and sending it to the Arduino. Arduino obtains product information from a server, compares it with information from scanned products, generates invoices, and stores the information in the server.[21]

Fig no. 5: RFID Reader

E. RFID TAG

Smart barcodes are a sort of tracking technology used by RFID tags to recognize objects. RFID is short for "radio frequency identification," RFID tags exploit this innovation. The reader receives the data from the tag through these radio waves and then transfers it to the PC program. The use of RFID tags is common most probably used to trace commodities, however, they can also be utilized to trace automobiles, animals, and citizens who are suffering from Alzheimer's disease. RFID tags are another name for RFID tags. The microchip in an RFID tag is installed on a substrate with a radio antenna and has a 12-byte unique identification number.[22],[23]

Fig No 6: RFID Tag

F. NODE MCU

The open-source IoT platform Node MCU is inexpensive. The first components were ESP-12 module-based hardware and ESP8266 Wi-Fi SoC-based firmware. Subsequently, support for the 32-bit ESP32 MCU was included. For the open source. Free prototype board designs for Node MCU firmware are available. Node MCU is an acronym for node micro-controller unit. Technically, Node MCU refers to the corresponding development tools. One and all RFID card is linked to a single product, and an RFID reader put on the cart may read the product information, including the cost and other details then transfer it to the Node MCU ESP8266. Following that, Node MCU processes the items in the cart and their total value before sending those results to the ESP8266 Webserver.[10]

Fig No. 7: Node MCU

G. AN IR SENSOR

In order to sense particular aspects of its environment, an electrical gadget called an infrared sensor which commonly ascertains or gives out infrared radiation. In addition to monitoring an object's heat production, infrared sensors have the ability to spot movement. To identify the customer in our project, we are employing IR sensors.[11]

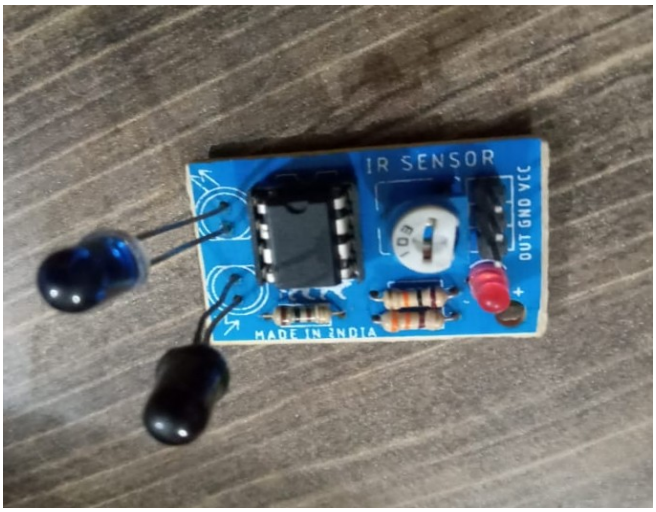

Fig No. 8: IR sensor

H. PUSH BUTTON:

A push button is a basic sort of switch that regulates a machine's or process's behavior. Metal or plastic is typically used to make the buttons. Push buttons can be flat or designed to fit comfortably around hands or fingers for use. Everything depends on the particular design. The push button has two default positions: open and closed.[18]

VI. CONCLUSION

We are prepared to draw the conclusion that a "Smart trolley utilizing RFID" is certainly a superb solution for the retail marketing business to expand its portfolio and keep up with technological advancements in light of the shifting trends in retail purchasing. It is obvious that saving time and labor is necessary. Yet, because they are very expensive, technologies that record data regarding interactions between actual items don't seem to be developed enough for the consumer market. Even if such knowledge has been made available, its decoding is frequently just as challenging as its registration because there is no established taxonomy or consistent classification system. There are numerous attempts to standardize, but it will probably take years. The need to integrate new technology into the retail infrastructure that currently exists, which frequently uses outdated and incompatible systems, is a related issue. Also, the setup for retail sales results in a large increase in the volume of electronic transactions, which present systems cannot handle. Hence, using the conclusion as support, we can state that: Automated billing of products using the notion of a smart trolley will be a more practical choice in the future. The system performs admirably and is effective and small. The trolley's commercial usefulness will be the first of its type. With the assistance of the appropriate sensors, this device records the data of various products.

VII. FUTURE WORKS

The major goal of the smart trolley is to save the client's time. By doing this, the crowds that may collect in malls in the future due to population growth may be prevented, computation time is cut down, the likelihood of an error is decreased, and the consumer is able to save money. There won't be any money-related stress while shopping if one can effortlessly purchase items that fit their budget. It can be utilized widely after this.

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